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Morphological Observations on the Bellerophont *Ptomatis patulus* (Hall) (Gastropoda, Bellerophontacea)

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INTRODUCTION

The bellerophont genus *Ptomatis* Clarke, 1899, is readily distinguished by its flattened, greatly expanded, bell-shaped aperture, shallow, V-shaped sinus, and strongly developed parietal callus. The type species, *Ptomatis patulus* (Hall), 1843, occurs persistently but not in great abundance in the middle Devonian mudstones of North America. Recently, the genus *Ptomatis* has been placed in the sinuitid subfamily Grandostomatinae on the basis of its similarities to the Ordovician genus *Grandostoma* Horný, 1962 (Horný, 1963).

Examination of numerous individuals of *Ptomatis patulus* from the middle Devonian of New York has revealed interesting points pertaining to shell structure and the significance of the posterior sinus in that species.

I am indebted to Dr. Roger L. Batten of the American Museum of Natural History, Dr. Ellis L. Yochelson of the United States Geological Survey, and also Messrs. Thomas Waller and Stephen Jay Gould, both of Columbia University, for their helpful suggestions and criticisms of this paper. Dr. Clinton Kilfoyle of the New York State Museum and Science Service very generously permitted me to examine on loan the type speci-

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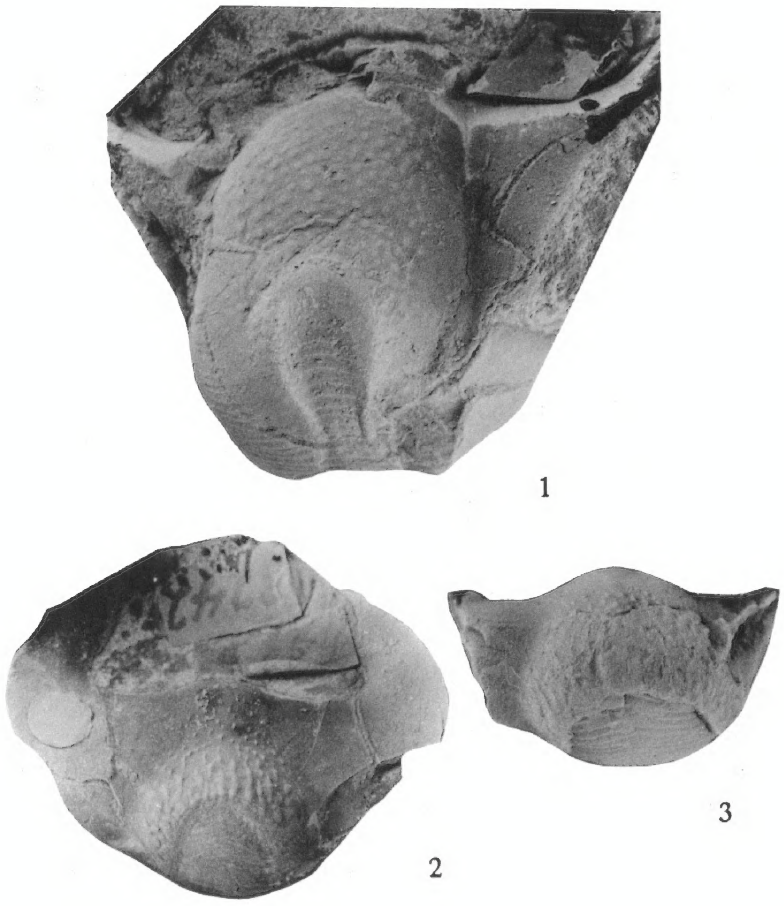

FIGS. 1–3. *Ptomatis patulus* (Hall). 1. A.M.N.H. No. 5433/11, middle Devonian, near Hamilton, New York, apertural view of broken specimen, showing spatulate parietal depression. × 2. 2. N.Y.S.M. No. 3242, middle Devonian, New York, apertural view, showing enlarged parietal depression. × 1¾. 3. N.Y.S.M. No. 3241, middle Devonian, Onondaga County, New York, apertural view, showing parietal depression enlarged through breakage. × 2.

mens of *Ptomatis patulus* (Hall). The present author accepts full responsibility for all opinions stated in this paper.

ABBREVIATIONS

A.M.N.H., the American Museum of Natural History
N.Y.S.M., the New York State Museum, Albany

POSTERIOR SINUS AND PARIETAL DEPRESSION

Adult individuals of *Ptomatis patulus* possess an exaggerated explanate aperture that extends posteriorly well beyond the margin of the earlier whorls. The posterior apertural extremity reflexes into a marked sinus and is abaperturally elevated into a rather broad low fold. Pustulate parietal inductural deposits are usually massively developed in this species, but are either lacking, or less strongly developed, in a subcircular area immediately in front of the posterior sinus.

Knight (1941, p. 284) thought that this subcircular area might have been excavated by the abrasion of this portion of the shell dragging over the bottom. It is difficult, however, to imagine a way in which this portion of the shell could have touched bottom when the gastropod was moving, since the foot mass would undoubtedly have been between the shell and the substrate. Moreover, detailed examination of a specimen with this feature beautifully preserved (fig. 1) clearly shows a spatulate depression that did not develop by a wearing away of the inductural wash. Growth lines, developing into collabral costae within the depression, can be traced down into this depression and up out of the other side, strongly suggesting that this was the extrusional locus of a reflexed portion of mantle. Another individual (fig. 4) presents a variant pattern of this feaure, in which the growth lines are posteriorly arranged parallel to the long axis of the spatulate depression, separating anteriorly around the depression and, in effect, encircling it. In this case, the depression appears bounded by a thin, secondary, inductural deposit.

If torsion in this form is assumed (an assumption supported by the presence of a "normal" bellerophont anterior sinus, the presumable reflection of an anteriorly situated anus), the only immediately conceivable function for this parietal depression would be the accommodation of the posterior end of the foot mass itself. Perhaps it was functionally impossible for the entire foot mass to be withdrawn far into the aperture and earlier whorls, and the posterior portion of the foot might have nestled into this parietal depression.

Most individuals of *Ptomatis patulus* display a more laterally enlarged depression in the parietal callus than afforded by the previously described specimens. This exaggeration of the depression always occurs on the medial portion of the whorl, where the inductural wash is thinnest, and appears to have been accomplished both by resorption and breakage (figs. 2 and 3). Individuals with an irregular and jagged margin to the depression could have suffered sharp breakage of the thinner inductural layer either before or after death, whereas a smooth beveled margin

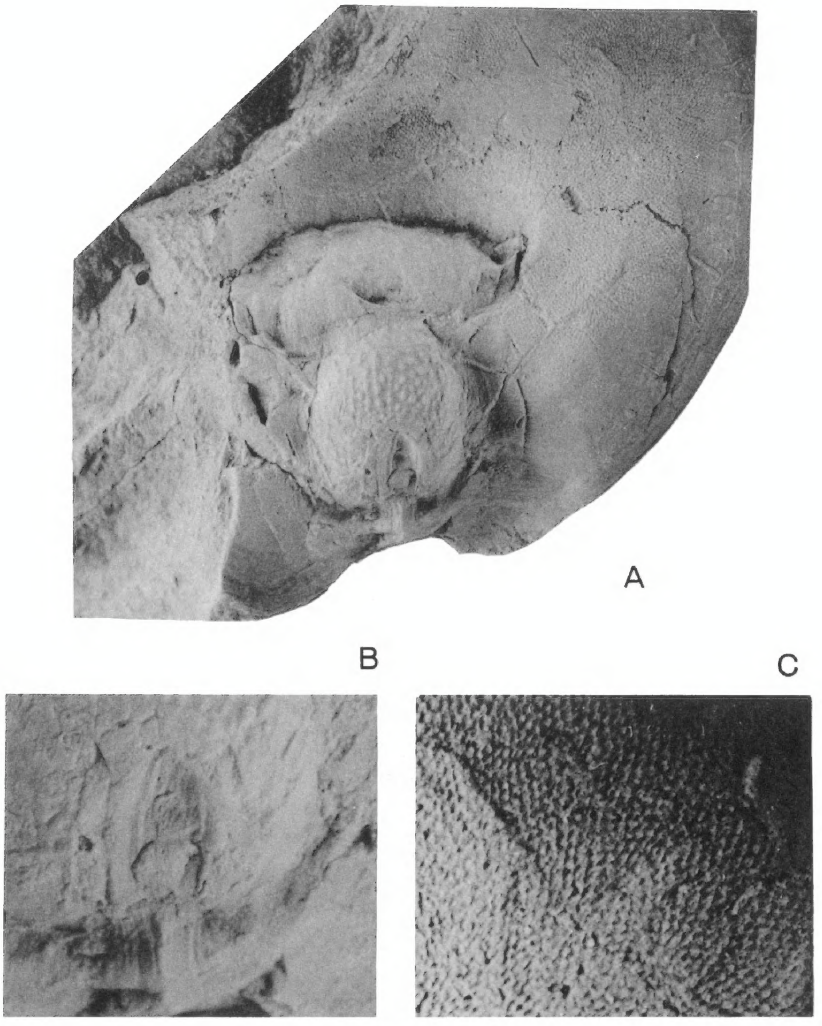

FIG. 4. *Ptomatis patulus* (Hall), N.Y.S.M. No. 3238, middle Devonian, Cayuga Lake, New York. A. Apertural view, showing parietal depression and prismatic shell structure. × 1½. B. Enlargement of parietal depression, showing growth-line behavior. × 3¼. C. Enlargement of prismatic shell structure near apertural margin. × 4.

can best be accounted for by resorption of the inductural wash during life.

SHELL STRUCTURE

One observed specimen of *Ptomatis patulus* preserves in the apertural

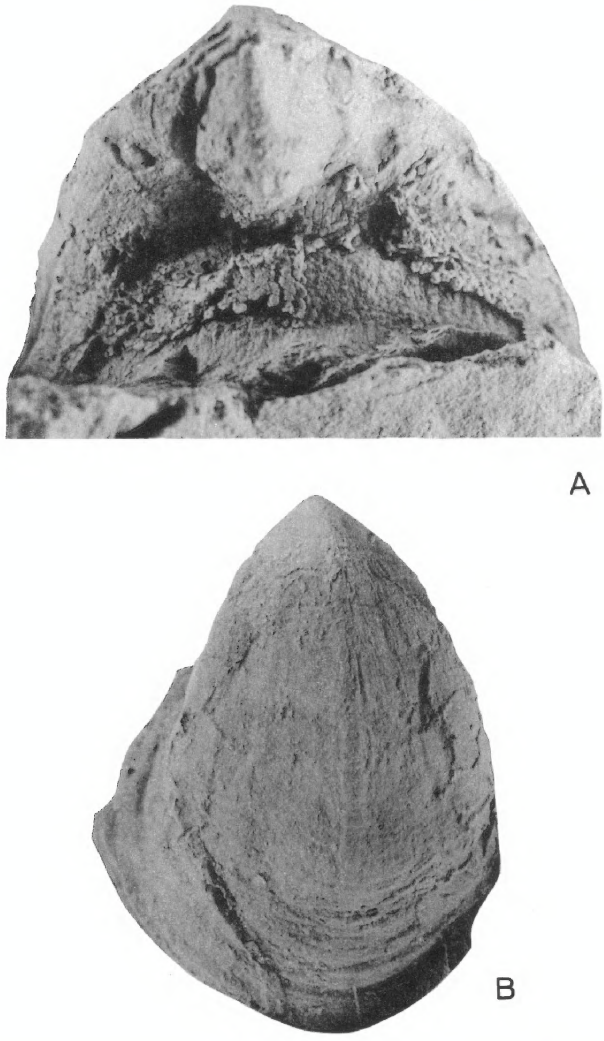

FIG. 5. *Cyrtonella mitella* (Hall), A.M.N.H. No. 28453, middle Devonian, Madison County, New York. A. Oblique apertural view, showing prismatic shell structure. × 6. B. Dorsal view, unreflected growth lines, showing absence of sinus. × 2½.

region a distinctive textural feature, very suggestive of prismatic shell structure, but on a scale large enough to be seen with the naked eye (fig. 4). Knight (1941, p. 284), in his generic discussion of *Ptomatis,* mentioned this textural feature and figured the same specimen. There can be little doubt that this is a structural element of the shell, since it occurs inside a layer of the shell that has been abraded.

The present author has observed a somewhat similar structure on a specimen of the monoplacophoran species *Cyrtonella mitella* (Hall). In the latter, the "prisms" are also confined to the apertural region and are megascopic (fig. 5).

Numerous fossil monoplacophoran species of the subfamily Tryblidinae Pilsbry display a peculiar polygonal shell pattern which has been interpreted as surface sculpture (Horný, 1955). This pattern is more probably preserved shell structure. A polygonal surface ornament, with the polygons having more than four sides, is difficult to interpret in terms of incremental molluscan shell growth.

Coarse prismatic shell structure has been reported by Turner and Rosewater (1958, p. 286) in the bivalve family Pinnidae in which, according to these authors, "these prismatic crystals, the largest produced anywhere in the Recent Mollusca, may be readily seen with the aid of a hand lens and in older specimens are often sufficiently large to be seen without magnification." Coarse prismatic shell structure, and the correspondingly large amount of conchiolin between prisms, has an apparent functional relationship to shell flexibility. Restriction of this structure to the apertural regions of the bellerophont and monoplacophoran shells might, similarly, be functionally related to increased flexibility and strength. On the other hand, this might be, in the case of these fossil mollusks, only an observational coincidence and a function of preservation.

CONCLUSIONS

An unusual parietal depression on the bellerophont *Ptomatis patulus* (Hall) is interpreted as having been of functional significance to the adult in the accommodation of an extruded foot mass which could not be fully withdrawn into the restricted volume of the earlier whorls.

Ptomatis patulus (Hall) also displays an interesting prismatic shell structure quite like that observed in the monoplacophoran genus *Cyrtonella* (Hall). No genetic significance is attached to this similarity at the present time.

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